

Use of human perivascular stem cells for bone regeneration.

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Public Summary:

An ideal mesenchymal stem cell (MSC) source for bone tissue engineering has yet to be identified. Such an MSC population would be easily harvested in abundance, with minimal morbidity and with high purity. Our laboratories have identified perivascular stem cells (PSCs) as a candidate cell source. PSCs are readily isolatable (through fluorescent activated cell sorting) from adipose tissue and have been previously shown to be indistinguishable in phenotype and differentiation potential to MSCs. In the present study we indicate 3 different surgical defects models that could be used with PSCs. These include an intramuscular implantation model, a calvarial defect model, and a femoral segmental defect model. The video article shows the proper procedure for performance of these bone formation assays.

Scientific Abstract:

Human perivascular stem cells (PSCs) can be isolated in sufficient numbers from multiple tissues for purposes of skeletal tissue engineering(1-3). PSCs are a FACS-sorted population of 'pericytes' (CD146+CD34-CD45-) and 'adventitial cells' (CD146-CD34+CD45-), each of which we have previously reported to have properties of mesenchymal stem cells. PSCs, like MSCs, are able to undergo osteogenic differentiation, as well as secrete pro-osteogenic cytokines(1,2). In the present protocol, we demonstrate the osteogenicity of PSCs in several animal models including a muscle pouch implantation in SCID (severe combined immunodeficient) mice, a SCID mouse calvarial defect and a femoral segmental defect (FSD) in athymic rats. The thigh muscle pouch model is used to assess ectopic bone formation. Calvarial defects are centered on the parietal bone and are standardly 4 mm in diameter (critically sized)(8). FSDs are bicortical and are stabilized with a polyethylene bar and K-wires(4). The FSD described is also a critical size defect, which does not significantly heal on its own(4). In contrast, if stem cells or growth factors are added to the defect site, significant bone regeneration can be appreciated. The overall goal of PSC xenografting is to demonstrate the osteogenic capability of this cell type in both ectopic and orthotopic bone regeneration models.

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